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## ABSTRACT

Nolan's State Hypothesis on the assimilation of computer technology by organizations provides one of the most popular frameworks for describing and managing the growth in corporate data processing. The model has achieved a high level of acceptance despite little formal evidence of its reliability or robustness. One previously published test was unable to confirm the predicted S-shared growth curve for EDP budgets. Our study of 273 large Canadian organizations tested another prediction of the Stage Hypothesis--that more "mature" DP groups would be more likely to have a formal Data Administration function than less "mature ones--and failed to find the hypothesized relationship. Further analysis of the results revealed that the variables used to assess DP maturity do not exhibit a sufficient degree of intercorrelation for them to be considered aspects of a common construct. These results cast considerable doubt on a basic premise of the Stage Hypothesis.

## INTRODUCTION

Nolan's Stage Hypothesis (1973) on the assimilation of computer technology by organizations has attracted much interest from both practitioners and academics since its introduction in 1973. At the time of its initial publication, data processing departments had been experiencing rapidly growing budgets for a decade or more, while the great promised benefits of computerization had proven disappointingly elusive. This often led to a disenchantment with computers on the part of managers outside the data processing area, and a retaliatory claim from within the computer department that they were somehow "different" from other corporate activities and could not be properly managed or evaluated using traditional methods.

In this environment, the introduction of the Stage Hypothesis served several useful purposes. First, it claimed to explain, and therefore to a certain extent, to legitimize, the rapid growth in DP expenditures that had been experienced. In addition, it held out the welcome promise that the rate of growth could be expected to decline in the future. Perhaps even more importantly, the hypothesis provided a model of the process of corporate computerization as proceeding from Initiation through Maturity via a sequence of four, and later six, specific stages. Each stage is characterized by the types of computer applications in use, the organization and management of the data processing department, and its relationship with the rest of the corporation. Both DP and non-DP managers can use the model to reassure themselves, and to demonstrate to others that what they

are going through in their organization is a normal, perhaps even inevitable step toward ultimate success.

While the original formulation fo the Stage Hypothesis (Nolan, 1973) was entirely descriptive, later articles (Nolan, 1979; Gibson & Nolan, 1974) have incorporated a distinctly normative aspect. Once an organization has figured out what stage it is currently in, the model purports to show the types of developments that must occur in order to progress to the next stage, as well as specific recommended organizational and managerial strategies.

Considering the claimed power of the Stage Hypothesis, and the meager state of prior data processing management theory, it is not surprising that the model has been embraced eagerly by the profession. There are probably very few organizations with large data processing activities that have not, formally or informally, gone through the process of a "stage audit" to find out where they stand in terms of the model. It has also attracted considerable attention from MIS academics, many of whom are greatly concerned by the weakness of their field's theoretical base. However, while there is no denying the intrinsic plausibility of the Stage Hypothesis, it is essential that it be subjected to formal testing before adoption by either practitioners or academics.

One of the key predictions of the original model was that DP budgets would exhibit an S-shaped growth curve during the progression through the stages. In fact, the observation of roughly S-shaped budget curves in three organizations was a major contributing factor in the original development of the model. Lucas and Sutton (1977) tested this prediction using data for twenty-nine California county governments spanning a wide range in DP sophistication and expenditure, and were unable to confirm the hypothesized S-shape. They found that the best predictor of the DP budget time series was a simple linear model, perhaps not a very surprising result to anyone familiar with the customary, incremental approach to budgeting. On the other hand, it could be argued that this study was not a valid test of the model since the budget setting process in governmental organizations can be influenced by a variety of extraneous factors.

We have recently completed an extensive survey of the Data Administration (DA) function in Canada (McCririck, 1979), which has provided an opportunity to test another aspect of the Stage Hypothesis. Two hundred and seventy-three organizations, comprising a representative sample of both the public and private sectors, and all major industries, completed lengthy questionnaires covering data administration and data processing activities. The monthly DP budgets for computer hardware ranged from $1,200 to $3,000,000. Figure 1 shows a frequency distribution of these budgets.

| Computer Hardware Budget ($1,000) | Number | Cumulative Percentage |
|---|---|---|
| 0-25 | 71 | 29 |
| 26-50 | 56 | 52 |
| 51-75 | 23 | 61 |
| 76-100 | 29 | 73 |
| 101-200 | 16 | 80 |
| 151-200 | 19 | 88 |
| 201-500 | 15 | 94 |
| 501-1,000 | 8 | 97 |
| 1,001-3,000 | 7 | 100 |
| | 244* | |

*Twenty-nine organizations failed to respond to this question.

Figure 1. Frequency Distribution of Hardware Budgets

The dependent variable in this analysis was the existence, or not, of a formal DA function. The questionnaire completed by DP managers contained a one paragraph description of the Data Administration function, and asked if the respondent's organization had an identifiable unit specifically responsible for this task. The survey package also contained a second questionnaire concerning the detailed activities and responsibilities of the data administration unit. The data processing managers were asked to have this questionnaire completed by the person responsible for this function if it existed. Values were assigned to our dependent variable by comparing the responses from these two sources. In 238 cases out of 254, the DP manager's answer and the response, or lack of one, to the second questionnaire were in clear agreement. In sixteen cases, the DP manager stated that there was no formal data administration unit, but these answers were recorded to "Yes" on the basis of the information provided in the second questionnaire. In four other cases, the DP manager stated that there was a DA unit, but the responses to the second questionnaire showed that it did not meet the standards of the definitional paragraph. These four answers were recorded to "No." A lack of universal agreement concerning the constituents of the DA function was one obvious source of difficulty for this study. Many organizations have groups carrying the DA name, but with greatly diminished responsibility compared to the proposals in the literature.

Determining the independent variables for measuring the DP "maturity" of the organizations presented a more difficult methodological problem. Nolan (1973) describes the path through the stages in terms of four growth processes: Applications Portfolio Development, DP Organization, DP Planning and Control, and User Awareness. For each of these, he presents a general outline of the features characteristic of each stage. In principle, one can examine

The questionnaires were designed to permit a test of the Stage Hypothesis's prediction about data administration. In the original model, developed before data administration concepts were widely understood or accepted, the emergence of a formal DA function was one of the characteristics of a "mature" Stage IV organization. Nolan noted, however, that there would doubtless be more S-shaped curves as new DP concepts and technologies emerged (Nolan, 1975). In more recent versions of the model (Gibson & Nolan, 1974; Nolan, 1978), Nolan has described a new S-curve corresponding to database technology expenditures. He contends that the assimilation of database technology requires four evolutionary stages similar to those of the original model. According to Nolan, the overlapping of the two four-stage patterns produces a six stage model of the evolution of the data resource function. The original Stage IV is renamed Integration, and Data Administration becomes a fifth stage, located immediately before the final Maturity stage. Thus, in either formulation, the Hypothesis associates the existence of a formal DA function with a DP activity near the high end of the "maturity" scale. By attempting to measure DP "maturity" in the organizations participating in our survey, we proposed to test this prediction.

## METHODOLOGY

We believe that it will be most useful to describe what we did and what we found in the order in which things actually happened, rather than what we would have done if we had known what the results would be. We anticipated that verification of the relationship with DP "maturity" would be a realtively routine aspect of our overall DA study. When results appeared that were quite different from what had been expected, a more careful examination of the underlying assumptions was required.

these growth processes in an organization and compare them with Nolan's descriptions to make a stage assignment.

Unfortunately, Nolan has never publicly explained precisely how to measure the growth processes. Thus, anyone wishing to use or test the model independently must rely on their own definitions and measurement techniques. We adapted the work of Mantha, Benbasat, and Dexter (1980), as a basis for defining the independent variables for our study. They have proposed a list of variables for measuring maturity of a DP activity based on a careful distillation of Nolan's writings on the Stage Hypothesis. Their major indicators are:

1. DP Organization Size--Organizations which have large DP activities tend to be more mature than organizations which have smaller activities.

2. User Awareness--More mature organizations have users and senior management which are more involved in the systems development effort.

3. DP Planning Mechanisms--More mature organizations have established planning committees and developed data flow models of the overall organization.

4. DP Control Mechanisms--More mature organizations use a charge-out system and enfore formal standards for the major DP functions.

5. Position of DP Activity in Organizational Structure--DP groups in more mature organizations are placed at a higher level in the organization, whereas less mature DP groups tend to be located under a functional authority.

6. DP History--More mature organizations tend to have more experience with computers and computer technology.

7. Portfolio Mix--More mature DP groups have an applications portfolio which includes more management control and strategic level information systems than less mature groups.

8. Performance Evaluation--More mature DP groups are evaluated less on clerical cost savings and more on contribution to overall organizational goals as specified in formal plans.

In Figure 2, we reprint the specific questionnaire items used to develop our DP Activity maturity measure.

We made no attempt to identify a particular maturity stage for each organization. As Nolan, himself, has pointed out, it sometimes happens that one gets inconsistent indications from the four growth processes, making assignments of a single stage somewhat arbitrary. Fortunately, all that was required for our purposes was to distinguish more mature organizations from less mature ones. The analysis technique used was multiple linear regression. This procedure requires that variables be measured on at least an interval scale. Because several of our questions have answers that form only a nominal scale, some transformations were required before the regression could be run. These are discussed in the next section. All of the data manipulation and analysis was performed using Version 7.01 of SPSS--the Statistical Package for the Social Sciences.

## REGRESSION VARIABLES

Two questions, numbers 2 and 15, address DP Organization Size. A preliminary test showed that the correlation between "Number of EDP Employees" and "Hardware Expenditure" was greater than 0.8. In order to avoid collinearity difficulties, we dropped Question 15 from the regresson since it had more "missing cases."

2. What is the total staff complement reporting to the Manager of the EDP activity in your organization?

_____ Individuals

3. Please indicate, with reference to the following structure, the organizational location of the EDP activity in your organization. Please circle a number.

   1. In Accounting/Finance department

   2. In Operating department such as Marketing, Manufacturing, or Engineering.

   3. Service bureau or equivalent.

   4. Independent operating department reporting to Top Management.

   5. None of the above. Please describe the organizational location in the space following or on the back page of the questionnaire. Alternatively, please attach a copy of the organizational chart for your organization depicting the location of the EDP activity.

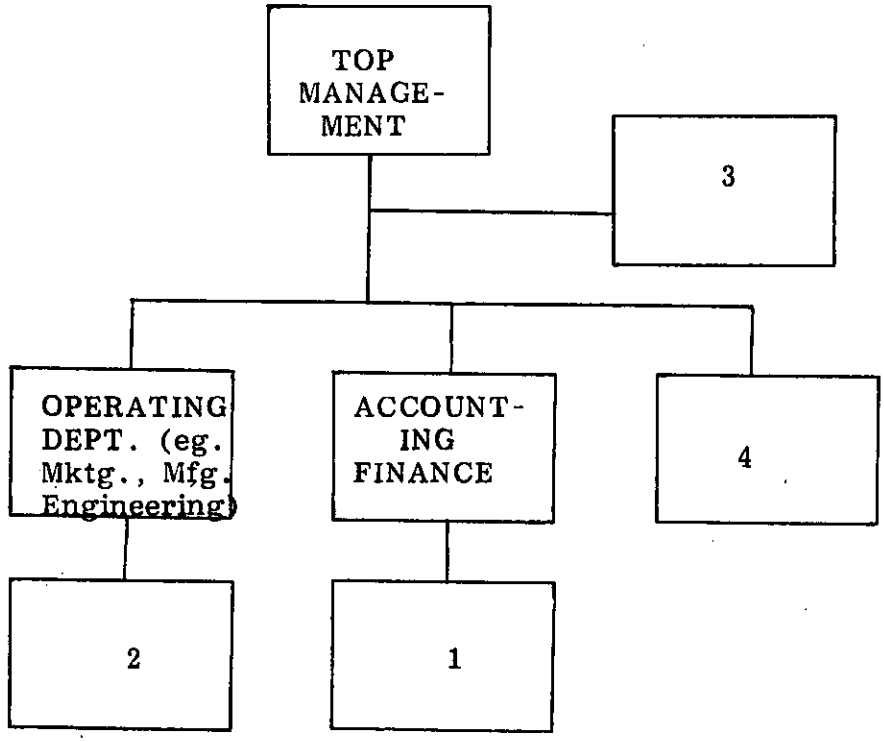


Figure 2. Questionnaire Excerpts

9. Which of the following best describes the accounting for EDP activity expenditures in your organization? Please circle a number.

   1. EDP costs are treated as corporate overhead and are not allocated proportionately to users.

   2. EDP costs are teated as corporate overhead and are allocated proportionately to users.

   3. Users are charged (in real dollars) for some of the EDP resources used and some costs are treated as corporate overhead.

   4. Users are charged (in real dollars) for the amount of EDP resources used.

   5. None of the above describes accounting for EDP expenditures in your organization. Please specify in the space below or on the back page of the questionnaire.

10. For each of the following functions in the EDP activity, please indicate whether formal standards, which are enforced, have been established in your organization. Circle either Yes or No.

   1. Yes No Project management

   2. Yes No Systems definition

   3. Yes No Systems design

   4. Yes No Programming

   5. Yes No Systems operation

   6. Yes No Systems maintenance

   7. Yes No Systems documentation

11. Please indicate how important the following criteria are in senior management's evaluation of the performance of the EDP activity in your organization. Circle a number from 1 to 5 where 1 indicates UNIMPORTANT and 5 indicates VERY IMPORTANT.

Figure 2 (continued)

A. Cost savings due to clerical staff reductions or increased efficiency of operation support systems.

Unimportant 1 2 3 4 5 Very Important

B. User satisfaction

Unimportant 1 2 3 4 5 Very Important

C. Meeting budgets

Unimportant 1 2 3 4 5 Very Important

D. Contribution to organizational goals are stated in the overall organizational plan.

Unimportant 1 2 3 4 5 Very Important

13. Has your organization established a Long Range or Strategic Planning Committee (or equivalent) to develop the EDP activity strategy for your organization?

___Yes ___ No

14. Has your organization developed a model of the organization that shows data flows across functional areas and hierarchical management levels?

___Yes ___No

15. Please indicate the approximate average monthly rental cost of computing hardware, including communication expenditures, in your organization for the past 12 months (use rental equivalent if leased or purchased)

_____dollars per month

16. Indicate the approximate number of years your organization has been using computers.

_____ years

17. What approximate percentage of the EDP budget is spent on the following three categories of systems (includes development, operation and maintenance)?

Figure 2 (continued)

1. ___% Operational Support System
   Systems which perform the routine transaction level activity required in the daily operation of the organization and report on the operational status of the firm so that management is aware of day-to-day activities. (Includes order entry systems, invoicing, payroll, etc.)

2. ___% Management Control Systems
   Systems which provide control information required by managers of departments, profit centres, etc. to measure performance, track the efficiency and effectiveness of operations, decide on control actions, formulate new decision rules to be applied by operational personnel, allocate resources and provide for coordination between several departments. (Includes manufacturing cost control systems, sales analysis systems, etc.)

3. ___% Planning Systems
   Systems which provide information for strategic level management (top management). This information will permit these managers to carry out their planning activities, such as formulating and revising company goals (over 3 years) and establishing company policies (includes financial planning systems, corporate models, etc.)

100% TOTAL

Questions 18 to 25 are concerned with the degree that Users, Senior Management and the EDP activity are involved in various new system development activities. Please circle a number from 1 to 5 to indicate the degree that the group is involved in the activity, where "1" indicates NOT INVOLVED and "5" indicates VERY INVOLVED.

* * * * * * * *

Figure 2. (continued)

19. Identifying new systems development projects

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

20. Determining costs of new systems development projects

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

21. Determining benefits of new systems development project

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

22. Ranking or prioritizing new systems development projects

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

Figure 2 (continued)

23. Developing a project schedule for new systems development projects

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 3 3 4 5 Very Involved

24. Managing a new systems development project

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

25. Designing a new computer based information or data processing system

USER
Not Involved 1 2 3 4 5 Very Involved

SENIOR MANAGEMENT
Not Involved 1 2 3 4 5 Very Involved

THE EDP ACTIVITY
Not Involved 1 2 3 4 5 Very Involved

Figure 2 (continued)

Questions 19A, 19B, 20A, 21A, 22A, 22B, 23A, and 24A all deal with user awareness, and were combined to form a single independent variable for the regression. Responses to these eight questions were transformed to standardized Z scores and then added. The Z score transformation ensures that no one question is weighted disproportionately in the sum. Finally, to make sure that these eight responses were measuring aspects of a single construct, a Cronbach's Alpha reliability test (Nannally, 1967) was performed that resulted in a score of 0.803, indicating that the items do, indeed, form a homogeneous scale.

A number of variables was used to capture different aspects of DP Planning and Control Mechanisms. The responses to Questions 13 and 14 were used directly. Responses to Question 9 were transformed into a binary variable CHARGE as follows. CHARGE was assigned a value of 1 if the response to Question 9 was either "3" or "4," indicating at least a partial charge-back of DP costs. A response of either "1" or "2" was transformed to a value of zero. Responses of "5" (none of the above) were coded as either 0 or 1 on the basis of the descriptive material provided by the respondents.

A variable representing the use of standards for systems development, SSCALE was constructed from the responses to the seven parts of Question 10. As with the composite User Awareness variable, the constituent responses were first standardized and then summed. Cronbach's Alpha reliability test gave a value of 0.801, indicating that it is permissible to consider these seven items as measuring aspects of a single construct.

The position of the DP activity in the organization structure was represented by a binary variable LEVEL computed from the responses to Question 3. A value of 0 was assigned to a DP activity reporting to a functional department, while a value of 1 was given for a DP activity reporting directly to top management. As in the case of the CHARGE variable, responses of "5" were classified by examination of the organization charts or descriptions supplied by the respondents. The DP History variable is simply the response to question 16.

Question 17.1 was used to measure Portfolio Mix. Because the answers to the three parts of this question total 100%, it was only necessary to include part (1) in the regression to give a measure of the relative importance of operational level systems.

DP Performance Evaluation was represented by the four parts of Question 11. No attempt was made to combine these into a single scale since it is quite possible for them to conflict with each other. For example, user satisfaction and budget adherence may often be mutually incompatible. Thus, each of the four parts of this question was included separately in the regression.

The regression variables are related to the questionnaire items and to the maturity indicators in Figure 3.

## RESULTS

The resultant linear regression equation is then:

$$\begin{aligned} DA = {} & A0 + A1(Q2) + A2(Q11A) \\ & + A3(Q11B) + A4(Q11C) + A5(Q11D) \\ & + A6(Q13) + A7(Q14) + A8(Q16) \\ & + A9(Q17.1) + A10(LEVEL) \\ & + A11(CHARGE) + A12(USCALE) \\ & + A13(SSCALE) \end{aligned}$$

When this regression was run with the data from our 273 respondents, the value of R-squared was only 0.130. While this result was highly statistically significant ($P < 0.005$), it indicates that a linear combination of these "maturity" variables is a

| Maturity Indicators | Variables | Questionnaire Items |
|---|---|---|
| DP Organization Size | Number of EDP Employees | 2 |
| User Awareness | USCALE | 19A, 19B, 20A, 21A<br>22A, 22B, 23A, 24A |
| DP Planning Mechanisms | Planning Committee<br>Data Flow Model | 13<br>14 |
| DP Control Mechanisms | CHARGE<br>SSCALE (Standards) | 9 (all parts)<br>10 (all parts) |
| Position of DP in Organization | LEVEL | 3 |
| DP History | Number of years | 16 |
| Appl. Portfolio Mix | % of Op. Ctrl. Sys. | 17.1 |
| Performance Evaluation | Criteria | 11 (all parts) |

Figure 3. Summary of Regression Variables

very poor predictor of the existence of a formal DA function. In addition, only one of the thirteen regression coefficients was individually significant at the .05 level. This was the coefficient of Q2, our DP Organization Size variable. Four other terms were significant at the .10 level:

Q11A--importance of cost savings in judging EDP Department performance;

Q14--existence of a formal data flow model;

Q16--years of data processing experience; and

SSCALE--existence of formal DP standards.

It is possible that the number of DP employees in an organization may not be the best measure of size for our purposes since it would seem to preclude the possibility of a small organization having a small, but nevertheless highly mature, DP department. Furthermore, it is easy to imagine circumstances where a large staff would be a direct reflection of a lack of DP maturity, as for example in the case of a large, offline data entry group. Perhaps, the ratio of DP employees to total staff would be a more appropriate measure. This alternative was tested and found to give much poorer results. While not particularly relevant to our immediate discussion, it is interesting to note that we found a negative correlation between this ratio and overall organization size, indi-

cating that DP departments do not need to expand at the same rate in order to keep up with overall organizational growth.

Another attempt to improve our results was then made, based on the observation that many of the characteristics included in our maturity construct are things that can only be found in larger DP departments with highly developed formal policies and procedures. It may also be true that only large organizations need, and can afford, the degree of specialization required for a separate DA function to emerge. Thus, this particular definition of maturity might only be appropriate for larger organizations. In fact, the incidence of DA rises dramatically with the size of the DP group among the organizations in our survey. Overall, we found that approximately 28% of the firms had a formal DA function. However, of the one-third of the firms with the smallest DP hardware expenditure, only 6% gave a positive reply, while the middle and upper one-thirds reported 30% and 49%, respectively.

The regression analysis was repeated for the two-thirds of the respondents with the largest hardware expenditures in order to test this possibility. The R-squared declined to 0.122, and the significance level to 84%, reflecting the smaller sample size and the restriction on the values of Organization Size, which had been the best predictor variable. In this version, Q14, dealing with the use of corporate data flow models, became very highly significant ($p < 0.001$), and it is interesting to note that the correlation coefficient is negative!

The relationship between our maturity variables and the existence of a formal DA function was clearly suspect. Examination of the individual correlations between maturity variable and the dependent variable, DA, showed that they ranged from -0.12, for Question 14, to 0.20, for Question 2. These certainly do not show any strong relationship between the maturity variables individually and the existence of a formal DA function. Because of the range observed among these correlation coefficients, Cronbach's Alpha test was performed on the independent maturity variables in the regression equation. The resulting Alpha was only 0.539, indicating that these variables cannot, in fact, be regarded as aspects of a single concept, maturity, or anything else.

This is the key finding alluded to in the discussion of methodology that would have altered our experimental procedure had it been foreseen. That is, the reliability test should have been performed before the regression to verify that we were talking about a common construct, as was done with each of the transformed variables. However, the intuitive plausibility of Nolan's maturity concept caused us not even to consider the possibility that it might not exist!

Once it had been determined that our set of maturity variables was not a good predictor of the existence of a formal DA function, it was tempting to see if there was anything else in the data that might do better. It was observed that certain industry classes had higher proportions of firms with a DA function than others. In particular, high concentrations of data administrators were found in the following industries: petroleum and coal products, telecommunications and communications, information processing equipment, utilities, financial institutions, insurance companies, and universities. With the exception of universities, it also seemed that this list covered the industries that have been most prosperous in recent years, and a check of the "Earnings Adjusted to Index" indicator of the Toronto Stock Exchange 300 Stock Price Index System confirmed that these industries, in general, did not suffer during the recent economic slowdown in Canada, while the other industry types did experience reduced earnings.

The argument in favor of a formal DA function is usually based on relatively long term benefits arising from more rational management and fuller exploitation of the data resource. Our survey suggests that, in fact, creation of the function is related to the availability of discretionary resources for experimentation. To test this, all responding firms were divided into two groups labeled "With Funds" and "Without Funds" on the basis of their industry classification, and a cross-tabulation performed between this variable and the existence of a formal DA function. The resulting chi-square coefficient was 5.970 with one degree of freedom, significant at the 98% level. Thus, just as Lucas and Sutton found a simple linear model the best predictor of DP budget growth, our data seems to indicate that industry prosperity is the best predictor of the existence of a formal DA function. However, there are a number of complicating factors which will be discussed in the following section that confound any such simple conclusion.

## DISCUSSION

Our study found that a linear combination of maturity variables is not a good predictor of the existence of a formal DA function. This result fails to confirm the Stage Hypothesis, but may be explained by the low reliability of the positive responses to the question on existence of a DA function. Our responding data administrators revealed that their power and responsibilities tended to fall far short of that contemplated by writers such as Nolan (1974) and Secrest (1975). With a few exceptions, data administrators reported within the DP activity seemed to have relatively limited, technical responsibilities for only a portion of the organization's total data resource--usually that data which could be accessed via a Database Management System. In fact, the position often seemed to be more of a DBMS support role rather than that of a "Chief Data Officer," with broad powers and responsibilities for setting and enforcing data usage policies, analogous to corporate financial or personnel officers.

Our data suggest that organizations with large, experienced data processing departments are more likely to have DA groups than smaller, newer ones, and also that firms in more prosperous industries are more likely to have tried it. We did not investigate the profitability of individual firms, but this data would not be hard to find. If this turns out to be the key factor, it is an indication that organizations view DA as an experiment to be tried when discretionary resources are available, rather than as the key to a rational information management program as it is described in the literature. It may be noted that only about 15% of the organizations that had a DA function had established it prior to acquiring a Database Management System.

The much more significant finding of our study is, however, the low intercorrelation observed among the maturity variables of the Stage Hypothesis. This means that either there is no such thing as the organizational DP maturity which serves as a foundation of the Stage Hypothesis, or that our statement of the model, through the variables described earlier, is faulty.

It may be that our results simply reflect the failure of our set of independent variables to capture the essence of Nolan's maturity concept. There is no way this possibility can be tested since the operational details of the stage audit process have been kept proprietary. By explaining our definition in detail here, we provide a starting point for those who may wish to improve on it.

However, before further empirical work is conducted, the underlying principles of the Stage Hypothesis should be critically reviewed. As we understand it, the Stage

Hypothesis was originally based on observation of the budgets and DP planning, organizing, and controling activities in only three companies. All of the companies were relatively large and had made early starts in computing. Thus, they faced similar exogenous economic and technical environments which may provide a plausible alternative explanation for the observed budget behavior. The model has always been described in terms of at least four stages, yet the S-shaped budget curve only has three distinct sections: a low growth period at the beginning, followed by a rapidly rising segment which is, in turn, followed by a stationary or slowly growing final phase. In all of the firms originally studied by Nolan, the transition from slow to fast growth occurred in 1966, coinciding with the first volume shipments of third generation computer systems and a buoyant national economy. The significant improvement in price-performance ratios, accompanied by extravagant hopes and claims for the new systems could have been responsible for the observed spurt in spending. Two of the firms made the other major shift, back to slowly growing DP budgets, in 1969, a period of general economic slowdown. (The curve for the third firm is too erratic for neat characterization.)

This suggests a completely different explanation for the data on which the Stage Hypothesis was based. We note that the early stages are all marked by non-optimal behavior of some sort. While it is easy to see why firms that were data processing pioneers went through these experiences, it is less clear why a company starting a decade or more later had to make all of the same mistakes. Perhaps it would be more useful to think of Data Processing Maturity as a concept relevant to the entire society, rather than an individual firm. This would be consistent with Nolan's original observations, while also helping to explain the absence of a coherent organizational maturity concept in our study. This view can also explain why data administration was a minor issue in Nolan's original model while it has become an entire stage in the most recent version. It is, in fact, a new stage in the growing sophistication of the data processing field, something that could not have been undertaken in the 1960's by even the most "mature" DP department, but which can, and arguably should, be adopted by even a beginning DP operation today.

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